Next Generation Solutions for the Energy Services Industry

Satish Kumar, Lawrence Berkeley National Laboratory
Steve Kromer, Enron Energy Services

ABSTRACT

Internet commerce is changing business practice through the development of more efficient and cost-effective business to business (B2B) and direct marketing models. The implications for energy-related information needs - construction management, integration across life-cycle, controls and monitoring of energy systems, commodity (electricity, natural gas, and greenhouse gas emissions) trading are huge. Future business success will depend in part on how efficiently a company can collect, analyze, and convert data into useful information to develop and implement business strategy. This paper discusses the strategy of existing companies that are providing on-line solutions to integrate the requirements and expectations of key players in the building/project delivery process. The paper will analyze the new trend, where the construction and energy efficiency sector is moving away from a “selling software” to a “selling services” model.

The paper investigates various new technologies such as eXtension Markup Language (XML), Enterprise Energy Management (EEM), Remote Data Acquisition Systems (RDAS), remote monitoring and controls, and real-time energy pricing that can and are being used to reduce risks involved with energy efficiency projects and offer a better return on investment. It also discusses how the recent advances in technology are reshaping the energy services landscape and the pivotal role that risk management strategies would play in maintaining competitive advantage in the energy services sector.

Prologue

Internet technology is changing the way business is conducted. The construction and energy efficiency industry are not untouched by this phenomenon. Since it is a relatively new field of research, this paper attempts to list various technologies and present a scenario of how an energy services company (ESCO) can make use of these budding technologies to gain a competitive advantage. The references in many instances come from business magazines, newspapers, and internet sites versus the traditional peer-reviewed literature. This paper reviews the major changes taking place in the building industry in general, and then constructs a scenario based on currently available but incomplete information that can have a profound impact on the way energy efficiency projects are implemented in the future. In the course of doing that, we have mentioned the name of companies, their web sites, and some of their products. This should not, under any circumstance, be construed as an endorsement of that company or of its products and any references are used for illustrative purposes only. Also, given the nature of the internet industry as shown by recent market events, the authors understand the dangers implicit in an attempt to prognosticate the future of energy services industry based on the technologies that are still not fully developed. We would still like to share our views with our professional peers to develop a better understanding of this evolving field.

Introduction

Internet technology offers tremendous opportunities for cost savings to all types of businesses by making the underlying processes and businesses transactions very efficient (Romm et al. 1999). The construction industry is also slowly waking up to its potential. Changes in the construction industry are also inducing changes in the energy efficiency industry because of the overlap in these two industries. Before we start a discussion of specific changes being brought about by the internet revolution, we briefly introduce the enabling technologies. This will be followed by an overview of the construction industry and finally of the energy efficiency sector.

Enabling Technology and Recent Market Development

The construction industry has been slow to institute internet B2B practices. However, research done by *Forrester Research* (Figure 1) predicts that the sector which barely did $0.4 billion of on-line business in 1999 is growing exponentially and will be worth $28.6 billion in 2003 (Forrester Research 1998). The on-line business conducted in the utility industry ramps up from $7.3 billion in 1998 to $169 billion in 2003. Although no specific numbers are available for building energy efficiency sector, it is reasonable to assume that the internet boom is also going to impact this industry since it is closely linked with the construction and utility industry.

The following technologies and recent market trends are forcing the construction and energy efficiency industries to reinvent their business practices in a highly competitive market:

1. E-commerce software applications provided by vendors such as *Oracle* (www.oracle.com), *Ariba* (www.ariba.com), and *Commerce One* (www.commerceone.com) allow B2B transactions at substantially reduced cost. These vendors through their software applications allow customers to have access to the on-line marketplace with a global network of suppliers and manufacturers. This direct model saves money and time and makes business and technology procurement extremely efficient (Gerstein, 2000). New business practices such as *Reverse Auction* used by *Freemarket* (www.freemarket.com) empowers the buyers with a technology that promotes competition in real-time among manufacturers of products and suppliers of services.
2. Application Service Providers (ASP) and Internet Data Centers (IDC) provide customized solutions to suit a business strategy, performance and growth needs. ASPs aim to save their customers the costs and hassle of owning and managing technology, by "renting" to them frequently-used applications they need. The application-hosting model combines the data center of an ASP, the bandwidth of a Network Service Provider (NSP), the application-specific expertise of consultants and value-added resellers, and technical expertise of systems integrators and independent software vendors (ISV). These applications can range from basic e-mail to groupware and data mart applications to extremely complex and demanding applications such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM). Companies such as *Exodus Systems* (www.exodus.com) and *Citrix* (www.citrix.com) take care of systems architecture and network design, network security, application and data hosting for any business in which the internet figures

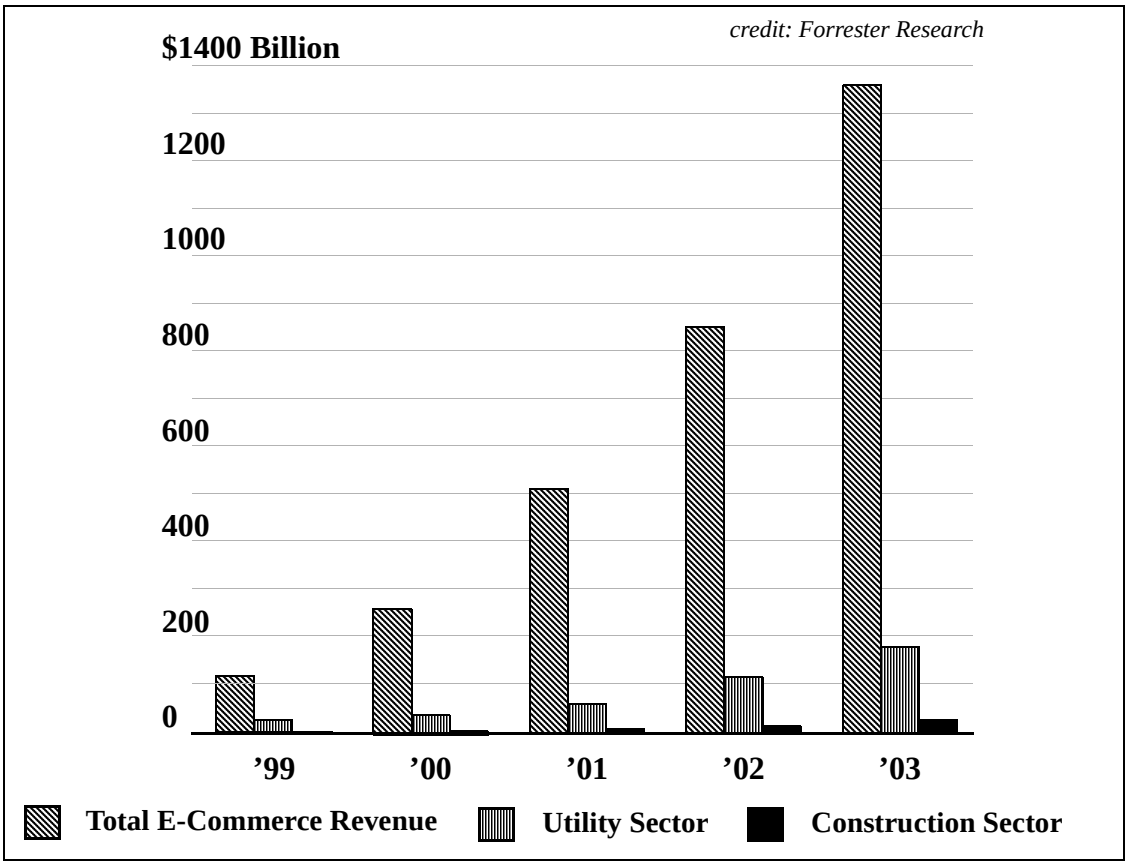

Figure 1. Projected E-Commerce Revenue Growth for Utility and Construction Sector

prominently. There is a huge potential for this market as companies can save valuable time and resources that can be used to develop core competency.

3. Recent developments in *Enterprise Energy Management* (EEM) applications such as Enerscape by *Silicon Energy* integrates all energy-related data throughout an enterprise, including data from existing building control systems, meters, and energy-related databases in any number of facilities, regardless of location, by combining internet technologies with a scalable, open architecture (www.siliconenergy.com).

4. *International Alliance for Interoperability* (IAI) specifications for Industry Foundation Classes (IFC) offer a standard schema for project information sharing in the global building industry (architecture, engineering, construction, and facilities-management) throughout the project life cycle, and across all disciplines and technical applications (iaiweb.lbl.gov).

5. The evolution of *eXtension Markup Language* (XML) allows industry-specific vocabularies to be developed that can help the players to conduct business transactions on the internet. It is an extension of the *Hypertext Markup Language* (HTML)—an internet standard, which differentiates between presentation (What you see—HTML) from data (What you get—XML). *aecXML* is an industry effort to develop XML vocabulary for the Architecture-Engineering-Construction (AEC) industries (Chmielenski 2000). An example of the industry-specific application that is relevant to the energy services industry is the frame-

work called the Green Building XML, developed by *GeoPraxis* (www.geopraxis.com) which will facilitate the transfer of building information including product characteristics and equipment performance data between manufacturer's databases, CAD applications, and energy simulation engines.

6. Advances in the field of software engineering and emergence of an open distributed object computing infrastructure such as *Common Object Request Broker Architecture* (CORBA) can be used to integrate different performance simulation environments and allow robust building simulation applications to run over the internet (Vinoski 1997, Mahdavi et al. 1999).
7. Advances in metering and sensor technology and data acquisition systems are making it cost-effective to collect and analyze data and develop sound business strategies. Companies like *National Instruments* (www.ni.com) and *Silicon Energy Systems* (www.siliconenergy.com) are coming out with innovative solutions in metering technology and enterprise energy management arena.
8. *Internet Billing* in telephone, cable, mortgage, brokerage, insurance, and utility sectors has provided the service providers a powerful medium to communicate directly with clients. Not only does it help in reducing the administrative cost of a very cumbersome process but it also establishes an interactive channel for targeted marketing and improved customer care (E-Source(b) 2000). *Checkfree* (www.checkfree.com) and *Transpoint* (www.transpoint.com) are the leaders in providing end-to-end, fully integrated electronic billing and payment solution for consumers, financial institutions, billers, and small businesses.

Internet and the Construction Industry

The construction industry is just beginning to see the potential that internet technology offers in terms of removing the inefficiencies that have become so well entrenched in the business processes. The payoffs can be huge in an industry which spends a staggering $500 million just on shipping blue prints around the world (The Economist, 2000). As a result, most companies are competing to develop brand names that can help them generate steady revenue down the road.

The Early Innovators

The B2B business model is changing the traditional method of executing a construction project. Most of the innovations have taken place in one of the following four fields that offer significant savings by cutting down costs:

- Web-based project management.
- Electronic construction archives.
- B2B integrators and service providers
- E-bidding on construction project.

There is a discernible trend among the new construction e-companies to become service providers instead of software developers. This is a direct result of the recognition that the "outsourced" model of construction business is ideally suited for such a shift. We'll briefly

discuss the market leaders in these segments and their strategy in attracting a skeptical construction community that is renowned for its resistance to embracing new technology.

BidCom (www.BidCom.com) and *Cephren* (www.cephren.com) are examples of solutions for electronic project management and electronic construction archives for large-scale commercial building projects. The software solutions that they have developed for the industry makes use of technologies that have been around for some time but it is the global reach of the internet that makes them so powerful and useful. These technologies are:

- A secured communication channel between the team members.
- An electronic chalkboard or bulletin board that can be used in the future to hold meetings and conferences on the internet.
- A robust and secured database for storing documents, drawings, bids, supplier's information etc. with layered levels of access that can be accessed anywhere, anytime.

Companies are vying for the pre-eminent position as the leading provider of end to end web-based solution for the building and the construction industry. These companies help manage risk, drive down costs, and complete large complex building projects on time by providing a highly flexible, secure environment for communication and collaboration, commerce, business process management and the delivery of up-to-the-minute content. They aim to be much broader than mere software providers. They are turning themselves into full-fledged business-to-business Internet hubs that start by amassing content (news, prices, gossip, job opportunities) tailored to their industry, to draw buyers and sellers to their sites. Once enough businesses are on-line to create liquidity, the hub turns into a marketplace, cutting out traditional middlemen and taking a commission from the transactions it hosts. (Economist 2000, Tedeschi 1999).

BuildNet (www.BuildNet.com) is targeting an altogether different, though no less lucrative market segment in the building industry -- the home builders. It is already responsible for one third of the homes built in this country through its unique schedule-driven, integrated construction management systems-designed to improve operating efficiency. BuildNet's internet-based, e-business platform is being developed to provide home builders access to an integrated on-line network designed to change the residential construction market by availing every aspect of a building project to real-time, on-line, integrated e-business links.

BuildPoint.com (www.buildpoint.com) is exclusively focussing on the e-bidding process. It’s web-based bid-management solution allows one to get the right information to the right people by centralizing the bid package information and standardizing the process. The web site allows one to tap into a network of general contractors and construction professionals, and manage the bidding cycle from document creation and distribution to response tracking.

The Energy Efficiency Sector

The internet technology is going to play a crucial role in the way energy projects are evaluated both on the client side as well as on the service provider side. As shown in Figure 2, web-based solutions will become part of the decision-making process on both sides of the fence. Organizations are starting to realize that the energy strategy for their organizations should not be limited to just cost reductions (E-Source(a) 1999) in their energy bills and that

non-energy benefits such as improved performance and health in workplaces (Fisk 1999), and enhancing productivity by reducing greenhouse gas emissions are important factors in the development of the corporate strategy (Romm 1999). They can also demand protection from energy price volatility that can have devastating impacts on their businesses (Lapson et al. 1998). Along with the capability and flexibility to control and monitor their energy demand and use inside their facilities, these organizations can make informed decisions and take steps to shield their businesses from spikes in energy prices. The energy service providers will need to respond to these demands by developing expertise and tools to provide a menu of options to their customers that can be customized to suit individual client's needs.

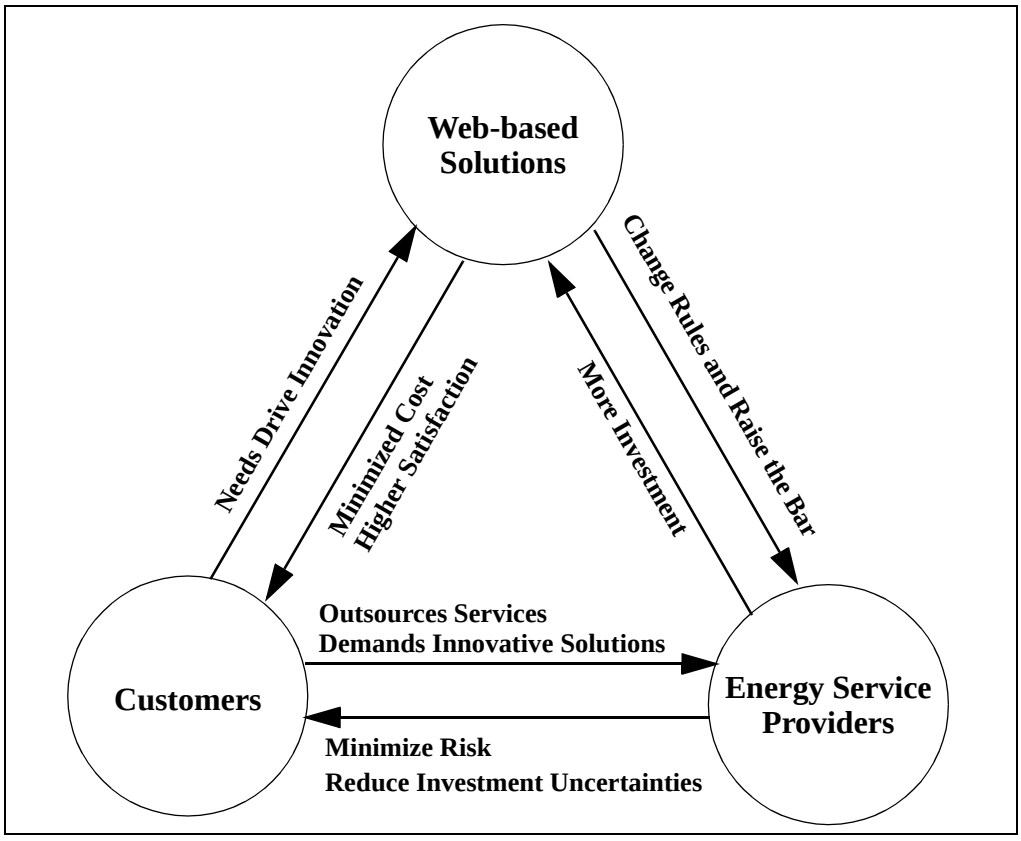

Figure 2. The Evolving Business Model for Energy Services

In the following paragraphs, we present some of the ways in which the services currently offered by ESCOs can or are being influenced by the recent developments and the demands being placed on them to adopt a *Systems Approach* to energy savings. Here, we try to link the new set of services that are being enabled by the advances in technology to different aspects of business practices in the field of energy services:

Project Inception and Evaluation

Depending on the requirements of the project, ESCOs may decide to offer a bundle of services or individually tailored solutions. The big companies may have a competitive advantage when it comes to providing end-to-end services to clients. The feasibility review and the

technical analysis in the initial stage of an energy-efficiency project can greatly benefit from the availability of the following information:

- Availability of electronic documents, drawings, and energy end-use data can be used by organizations to prepare a package for facilitating e-bidding on energy efficiency projects.
- Real-time access to building's energy signature to develop load profiles.
- Ability to perform a quick and accurate analysis by comparing the energy end-use with industry benchmarks to target cost-effective energy efficiency upgrades.
- Ability to convert electronic drawings and specifications into International Alliance for Interoperability (IAI) Simulation Objects and run real-time simulations over the internet using CORBA protocol.

All these capabilities can help in reducing the administrative costs and cut down the lead time in choosing a service provider and starting the project.

Project Design and Development

During the detailed design stage when the financial terms of the contracts are being developed, the needs for procurement of parts and services, performance measurement and verification on the demand side, existing utility rates and protection against electricity price spikes, etc. may be factored into the development of the contract. Parametric analysis can be performed by calibrating simulation model with metered data to target such energy efficiency measures that meet an organization’s internal rate of return criteria. Development of *Measurement and Verification* (M&V) protocols and standards are facilitating investments into energy efficiency projects by reducing risks and uncertainties associated with estimated energy and cost savings (US Department of Energy 1997, ASHRAE 2000).

We have already seen examples of companies that are specializing in one of these areas. As the B2B marketing models take off, it is quite possible that the leaders can carve out a market niche by developing expertise in one of the following fields as indicated in the conceptual sketch shown in Figure 3 on the next page. We can see an emergence of “Vertical Integrators” whose role would be to bring together the various players for the successful execution of the project. In this model, companies that can easily exchange information and are “connected” to the internet will hold advantages over their competitors. The other business model that is emerging is led by large companies who have the technical expertise, financial resources and marketing muscle to bundle all these services into one package. Some of the changes that can take place in the design and development of energy services contracts are listed below:

- Companies will either have access to in-house data banks or they’ll pay to get access to such information from other providers who will store data on similar and/or relevant projects organized by ECM type, geographical locations, O&M of facilities, indoor conditions, etc. This information can be supplemented with utility rate database to perform a detailed analysis of the energy demand and supply options.
- As more and more manufacturers and suppliers go on-line, cost estimation for the project can be performed by using services provided to access the E-marketplace.

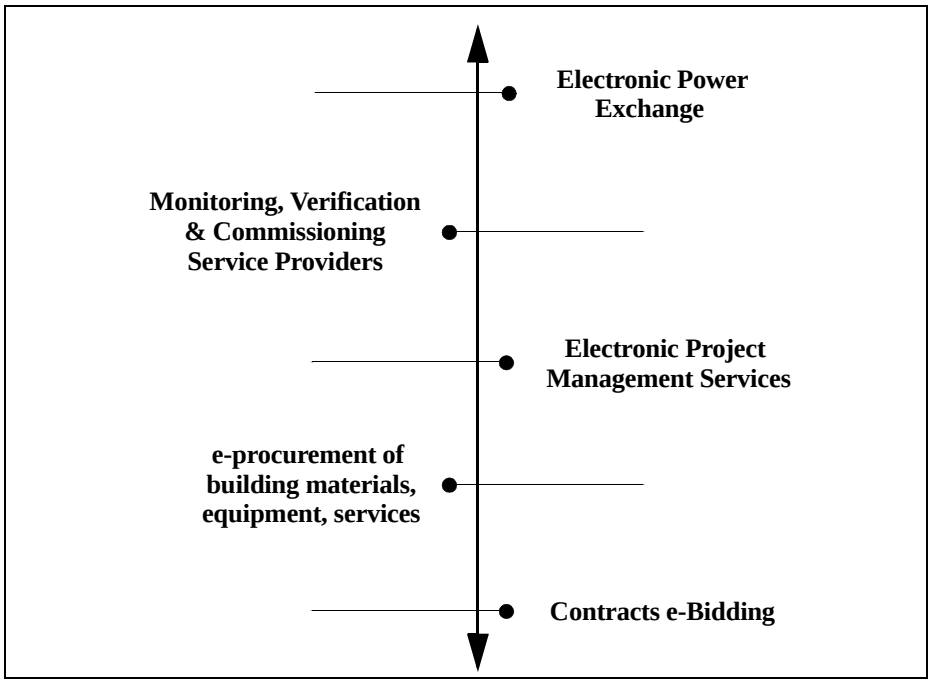

Figure 3. Vertical Integration Schema for Energy Services Industry

For example, equipment prices can be checked by logging into a B2B e-procurement web site, construction cost numbers can be retrieved another web site that is using XML to collect cost data, energy procurement can be performed at one of the many "Power Exchanges", and the interest rate information can be gathered from a finance web site specializing in providing loans for energy efficiency projects.

- Metering, Controls, and Sensing technology have made remarkable strides in the last few years. Silicon Energy (www.siliconenergy.com), National Instruments (www.ni.com) are developing technology based on open protocols that allows their products to interface with industry standard protocols such as ASHRAE's *BACNet* or IEEE compliant *General Purpose Interface Board* (GPIB), and also with proprietary dataloggers and metering and control equipment. In addition, innovative wireless solutions will be used to meter, collect, and analyze data from facilities across the world using wireless telemetry. They can feed data to the enterprise energy management systems.
- Enterprise Energy Management Systems will continue to be installed in large facilities because of the significant cost reductions they can offer in energy procurement, peak shaving and load shifting, O&M of energy systems, future budget allocation, and measurement and verification. For example, Enerscape's powerful EEM application suite integrates all energy-related data throughout an enterprise, including data from existing building control systems, meters, and energy-related databases in any number of facilities, regardless of location. Combining TCP/IP communication capabilities with a scalable, open architecture, Enerscape delivers advanced corporate resource-planning and cost-management capabilities by leveraging information that resides in disparate control systems and databases (www.siliconenergy.com).

EEMs can store, display, and perform complex energy analyses and predict trends to better manage the energy needs of large facilities.

- The amalgamation of spatial data with tabular data allows us to perform various types of parametric analysis. Spatial Information Management (SIM) is increasingly being used for sophisticated analysis (International Data Corporation, 2000). Figure 4 shows electricity rates and emissions factors (the two bar charts) for different states differentiated by the generating capacity. These tools help in deciding on the best geographical location for an industry that would offer the cheapest electricity rates vs. lowest emissions factors vs. some combination of the two parameters. As more data from the field of transportation, demographics, fuels for generating electricity, infrastructure support, environmental carrying capacity is incorporated in the SIM, better decision support system can influence key decisions at the inception of the environmental projects.

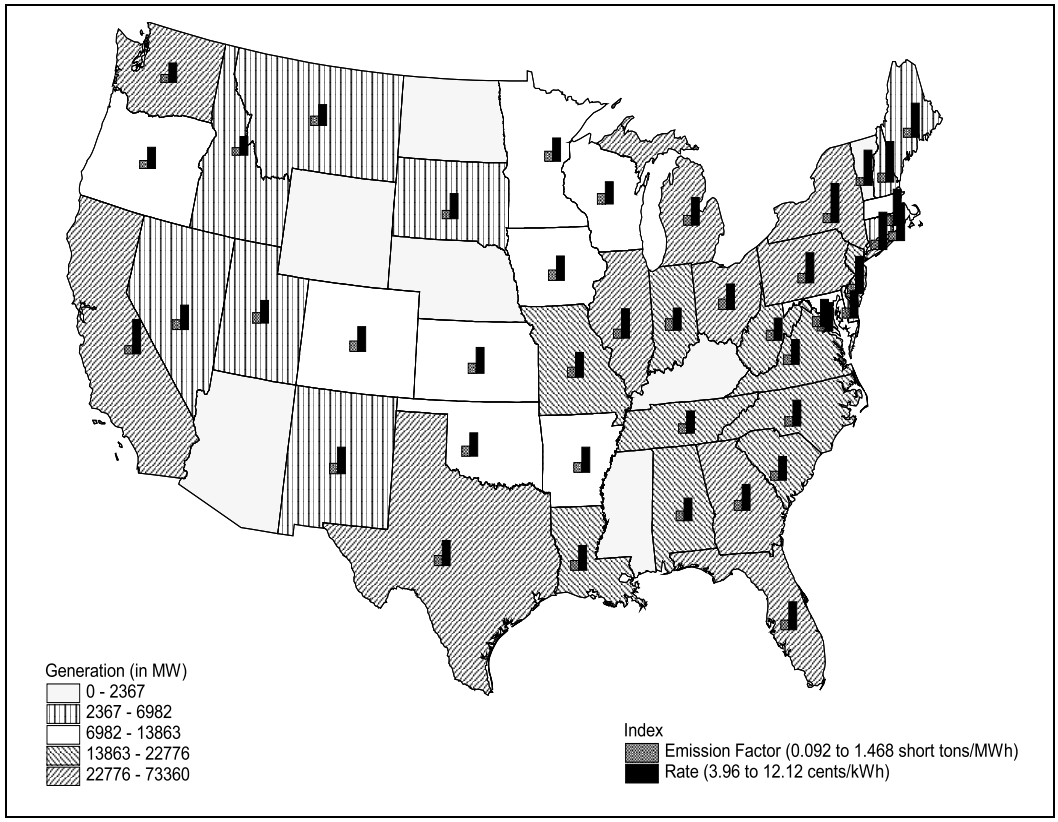

Figure 4. Electricity Rates and Emission Factors Aggregated at the State Level by Combining Spatial Data with Tabular Data in a GIS Application

Risk Management

So far this paper has concentrated on how the energy efficiency industry can utilize new information technology to develop and maintain competitive advantage. We will now discuss how the ability to collect and analyze energy efficiency cost and performance data can change the way energy assets are managed.

Managing the value of an energy efficiency project ultimately comes down to a trade off between the cost of collecting and analyzing performance data and the benefit of reduced uncertainty that such data can provide. The value of reduced uncertainty can be realized in several ways. In some cases, meeting an uncertainty criterion can be the basis for complying with a required measurement protocol (ASHRAE 2000). When compliance with such a protocol is required to obtain rebates or credits, the value of reduced uncertainty is explicit.

More generally however, reducing uncertainty is just one part of the business model of an Energy Service Company. Where the results of an energy efficiency project (typically known as "savings") are stipulated in a contract, there may be little incentive to invest in measurement of the retrofit. Even when the savings verification is required, every business has a different tolerance for risk and will therefore have a different optimum level of uncertainty reduction.

Arriving at an optimal level of risk reduction has been the goal of the currency markets and financial services industries for the past 20 years. Recently concepts in risk management that were developed for the financial services industry have been formalized in a discipline known as Financial Engineering. Financial engineering uses tools such as Monte Carlo simulation modeling to identify the drivers of uncertainty. Subsequent analysis can determine the contribution of each variable to overall uncertainty. This technique can be applied to energy savings models as well. Energy project planners may then decide whether the benefit of reduced uncertainty is worth the cost.

Once the drivers of risk have been identified, financial and contractual mechanisms such as degree day swaps and weather derivatives (Wall Stree Journal 2000), Measurement & Verification of energy savings etc. are available to mitigate them. The result can be significant cost savings and a more stable revenue flow. While many market variables that affect profit margins are not manageable, the price of the commodities often can be effectively managed to minimize price volatility. Through the use of swaps and other structured products or fixed-price physical transactions, market participants can minimize their exposure to margin risk and improve cash flow management (www.enron.com).

Conclusions

The hectic pace of technological changes and market conditions in the energy services sector are forcing big and small players to rethink their business strategy. While we can see a trend where big organizations would like: a) to outsource all energy related services with performance guarantees so that they can concentrate on their bottomline; b) to protect businesses which depend heavily on energy supply and weather from large price fluctuations in the energy prices; the onus to provide these services and benefit from the advances taking place in the field of internet technology would ultimately depend on the energy services community at large.

In summary, changes in information technology are bringing new opportunities to the energy efficiency sector. Consensus on standards such as XML and the adoption of financial engineering concepts in risk management will create advantages for those companies who can deliver this new level of bundled energy services. It seems more likely that after the recent shake-out in the internet sector, strategic alliances would be sought by companies with prom-

ising technology to complement their core expertise or they risk falling prey to large and established ESCOs that are looking for better return on investment. The industry is slow to realize the potential but it is our belief that educated customers and service providers with foresight and vision will help raise the bar for the entire industry.

References

ASHRAE. 2000, ASHRAE Guideline 14P - Measurement of Energy and Demand Savings, First Public Review, April 2000, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc., Atlanata GA.

Chmielenski, Thomas J. 2000, Building Materials E-Commerce Consortium Meeting, January 14, 2000 - Dallas, TX

The Economist. 2000. Construction and the Internet, The Economist, January 15.

E-Source (a). 1999, “Selling Energy Efficiency Services to Large Commercial Firms: Operating Cost Reductions are not the key” EB-99-6, May 1999

E-Source (b). 1999, “Internet Billing; A Lever to the Residential Market” EB-00-6, January 2000.

Fisk, William J. 1999, “Indoor Air Quality Handbook”, ed. by Spengler et al., McGraw Hill, 1999.

Forrester Research. 1998, “Resizing On-line Business Trade” (www.forrester.com), December 1998.

Gerstein, Marc. H. 2000, “Deciphering B2B E-Commerce” (www.marketguide.com), March 8, 2000.

International Data Corporation. 2000, “1999 Worldwide Spatial Information Management Markets and Trends” (www.idc.com).

Lapson, Ellen; Hornick, Robert; Fetter Steven; Pellechia, Ralph. 1998, “Electricity Price Spikes - Lessons Learned” FitchIBCA (www.fitchibca.com) Special Report, 1998.

Mahdavi, A.; M. Ilal; P. Mathew; R. Ries; G. Suter. 1999: “Aspects of S2”, Computers in Building: Proceedings of the CAADfutures '99 Conference, June 1999, pp. 185-196.

Romm, Joseph; Rosenfeld, Arthur; Herrman, Susan. 1999, “The Internet Economy and Global Warming” www.cool-companies.org, December 1999.

Romm, Joseph; 1999, “Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions”, Island Press, June 1999.

Tedeschi, Bob. 2000, Internet Reshapes the Construction Industry, E-Commerce Report in New York Times, February 21, 2000.

US Department of Energy. 1997: “International Performance Measurement and Verification Protocol,” DOE/EE-0157, US Department of Energy, Washington, D.C.

Vinoski, Steve. 1997, “CORBA: Integrating Diverse Applications Within Distributed Heterogeneous Environments”, IEEE Communications Magazine, February, 1997.

Wall Street Journal. 2000, “Weather Derivatives, which aim to hedge Nature, gain ground abroad”, Business Bulletin, Page A1, June 1, 2000.